

WHAT IS CLAIMED IS:

1. A legged mobile robot made up by a plurality of joint sites including a plurality of mobile legs, comprising

means for controlling characteristics of an actuator for carrying out, in combination, the control of gain and phase compensation of a servo controller of said actuator at each of said joint sites and the control of viscous resistance of an actuator motor.

2. The legged mobile robot according to claim 1 wherein said means for controlling the actuator characteristics sets, for the actuator of the joint site in need of high precision positioning control and/or orientation stability, the low range gain, the quantity of phase lead in the high frequency range and the viscous resistance of the joint to a large value, to a small value and to a large value, respectively.

3. The legged mobile robot according to claim 1 wherein said means for controlling the actuator characteristics sets, for the actuator of the joint site in need of mechanical passiveness and fast response characteristics, the low range gain, the quantity of phase lead and the viscous resistance of the joint to a small value, to a large value and to a small value, respectively.

4. The legged mobile robot according to claim 1 wherein said means for controlling the actuator characteristics sets, for the actuator of the joint site in need of buffering the force of impact and performing followup control of the high range, the low

range gain, the quantity of phase lead and the viscous resistance of the joint to a small value, to a large value and to a small value, respectively.

5. The legged mobile robot according to claim 1 wherein said means for controlling the actuator characteristics switches between first actuator characteristics of setting the actuator of each joint site to a large value of the low range gain, a small quantity of the phase lead, and to a large value of the viscous resistance of the joint and second actuator characteristics of setting the actuator of each joint site to a small value of the low range gain, a large quantity of the phase lead, and to a small value of the viscous resistance of the joint, at each step of a shifting operation on legs.

6. The legged mobile robot according to claim 5 wherein said means for controlling the actuator characteristics switches between first actuator characteristics of setting the actuator of each joint site to a large value of the low range gain, a small quantity of the phase lead, and to a large value of the viscous resistance of the joint and second actuator characteristics of setting the actuator of each joint site to a small value of the low range gain, a large quantity of the phase lead, and to a small value of the viscous resistance of the joint, at each step of walking operation on legs.

7. The legged mobile robot according to claim 6 wherein said means for controlling the actuator characteristics sets, at a stage of commencing the walking movement, the characteristics of actuators for respective joint sites of a knee joint pitch axis, ankle roll and pitch axes, body trunk roll, pitch and yaw axes, hip joint roll and pitch axes and a neck pitch axis to a large value of the low range gain, a small

quantity of phase lead in the high frequency range and to a large value of the viscous resistance of the joint, and wherein said means for controlling the actuator characteristics sets the characteristics of actuators for respective joints of a shoulder pitch axis and an elbow pitch axis to a small value of the low range gain, a large quantity of the phase lead and to a small value of the viscous resistance of the joint.

8. The legged mobile robot according to claim 6 wherein said means for controlling the actuator characteristics sets, at a stage when the leg in a flight state is uplifted and the reactive force from the floor, received by the foot sole thereof, is equal to zero, for characteristics of actuators for the knee joint pitch axis, ankle roll axis and the ankle pitch axis of the leg in the flight state, a small value of the low range gain, a large quantity of the phase lead and a small value of the viscous resistance of the joint.

9. The legged mobile robot according to claim 6 wherein said means for controlling the actuator characteristics sets, at a stage when the walking movement of the leg in a flight state proceeds and the leg touches the floor, with the reactive force from the floor, received by the foot sole thereof, being approximately equal to that during the time when both legs are in the stance position, the characteristics of actuators for the knee joint pitch axis, ankle roll axis and the ankle pitch axis of the leg in the flight state to a large value of the low range gain, a small quantity of the phase lead in the high frequency range and to a large value of the viscous resistance of the joint.

10. The legged mobile robot according to claim 6 wherein, in each stage of the walking movement, said means for controlling the actuator characteristics sets, for characteristics of actuators for driving the respective joints in which emphasis is placed on the positioning accuracy, first characteristics in which the low range gain is of a large value, the quantity of phase lead is of a small and the viscous resistance of the joint is of a large value.

11. The legged mobile robot according to claim 6 wherein, in each stage of the walking movement, said means for controlling the actuator characteristics sets, for characteristics of actuators for driving the respective joints in which emphasis is placed on the mechanical passiveness or on the fast response characteristics, second actuator characteristics in which the low range gain is of a small value, the quantity of phase lead is of a large value and the viscous resistance of the joint is of a small value.

12. The legged mobile robot according to claim 6 wherein, in each stage when the link state formed by the floor touchdown site of the robot body and the floor surface is changed over between the open link state and the closed link state, said means for controlling the actuator characteristics switches, during the walking movement, the characteristics of the actuators driving the respective joints between first actuator characteristics and second actuator characteristics.

13. The legged mobile robot according to claim 5 wherein, in each stage of the robot going up or down the stairs, said means for controlling the actuator

characteristics switches the actuator of respective joint sites between first actuator characteristics in which the low range gain is of a large value, the quantity of the phase lead is of a small value and the viscous resistance of the joint is of a large value and second actuator characteristics in which the low range gain is of a small value, the quantity of the phase lead is of a large value and the viscous resistance of the joint is of a small value.

14. The legged mobile robot according to claim 13 wherein, in a stage when both legs are in the stance position prior to going up or down the stairs, in the course of the operation of going up or down the stairs, said means for controlling the actuator characteristics sets the characteristics of the actuators of all of the joint sites, to the first actuator characteristics in which the low range gain is of a large value, the quantity of the phase lead in the high frequency range is of a small value and the viscous resistance of the joint is of a large value.

15. The legged mobile robot according to claim 13 wherein, in a stage when a first step is made for going up or down the stairs, in the course of the operation of going up or down the stairs, said means for controlling the actuator characteristics sets the characteristics of the actuators of the knee joint pitch axis and the ankle roll and pitch axes of the leg in the flight condition to the second actuator characteristics in which the low range gain is of a small value, the quantity of the phase lead is of a large value and the viscous resistance of the joint is of a small value.

16. The legged mobile robot according to claim 13 wherein, in a stage when the leg

of the first step has touched the tread face one step higher or lower, in the course of going up or down the stairs, said means for controlling the actuator characteristics sets the characteristics of the actuators of all of the joint sites to the first actuator characteristics in which the low range gain is of a large value, the quantity of the phase lead in the high frequency range is of a small value and the viscous resistance of the joint is of a large value.

17. The legged mobile robot according to claim 13 wherein, in a stage when the leg which touches the tread one step higher or lower becomes a leg in the stance state, and the leg which has so far been the leg in the stance position is uplifted, in the course of going up or down the stairs, said means for controlling the actuator characteristics sets the characteristics of the actuators of the ankle roll axis and the ankle pitch axis of the leg in the flight condition to second actuator characteristics in which the low range gain is of a small value, the quantity of the phase lead is of a large value and the viscous resistance of the joint is of a small value.

18. The legged mobile robot according to claim 13 wherein, in a stage when the second step has touched the tread two steps higher in the course of going up or down the stairs, said means for controlling the actuator characteristics sets the characteristics of the actuators of all of the joint sites to the first actuator characteristics in which the low range gain is of a large value, the quantity of the phase lead in the high frequency range is of a small value and the viscous resistance of the joint is of a large value.

19. The legged mobile robot according to claim 13 wherein, in each stage of the movement of going up or down the stairs, said means for controlling the actuator characteristics sets the characteristics of the actuators for driving respective joints, for which emphasis is placed on positioning accuracy, to first actuator characteristics in which the low range gain is of a large value, the quantity of the phase lead is of a small value and the viscous resistance of the joint is of a large value.

20. The legged mobile robot according to claim 13 wherein, in each stage of the movement of going up or down the stairs, said means for controlling the actuator characteristics sets the characteristics of the actuators for driving respective joints, for which emphasis is placed on mechanical passiveness or fast response characteristics, to second actuator characteristics in which the low range gain is of a small value, the quantity of the phase lead is of a large value and the viscous resistance of the joint is of a small value.

21. The legged mobile robot according to claim 13 wherein, in each stage of switching of the link state defined by the floor touching site of the robot body and the floor surface, in the course of going up or down the stairs, between the open link state and the closed link state, said means for controlling the actuator characteristics switches the characteristics of the actuators driving respective joints between the first and second actuator characteristics.

22. The legged mobile robot according to claim 5 wherein, in each stage of the

turning movement of the robot body, said means for controlling the actuator characteristics switches the actuators of the respective joint sites between first actuator characteristics in which the low range gain is of a large value, the quantity of the phase lead is of a small value and the viscous resistance of the joint is of a large value and second actuator characteristics in which the low range gain is of a small value, the quantity of the phase lead is of a large value and the viscous resistance of the joint is of a small value.

23. The legged mobile robot according to claim 22 wherein, in a stage of commencing the turning movement of the robot body, said means for controlling the actuator characteristics sets the characteristics of the actuators of all of the joint sites forming the robot body to a large value of the low range gain, a small quantity of the phase lead in the high frequency range and to a large value of the viscous resistance of the joint.

24. The legged mobile robot according to claim 22 wherein, in a stage when the leg in the flight state is uplifted and the reactive force from the floor received by the foot sole thereof is zero, said means for controlling the actuator characteristics sets the characteristics of the actuators of the knee joint pitch axis and the ankle roll and pitch axes of the leg in the flight state to a small value of the low range gain, a large quantity of phase lead and to a small value of the viscous resistance of the joint.

25. The legged mobile robot according to claim 22 wherein, in a stage when the



turning movement of the robot body progresses such that the leg in the flight state touches the floor and the reactive force from the floor received by the foot sole thereof is approximately equal to the reactive force during the time when both legs are in the flight state, said means for controlling the actuator characteristics sets the characteristics of the actuators of the knee joint pitch axis and the ankle roll and pitch axes of the leg in the stance state to a large low range gain, a small quantity of phase lead in the high frequency range and to a large viscous resistance of the joint.

26. The legged mobile robot according to claim 22 wherein, in each stage of the turning movement, said means for controlling the actuator characteristics sets the characteristics of the actuators for driving the respective joints, for which emphasis is placed on the positioning accuracy, to first actuator characteristics in which the low range gain is of a large value, the quantity of the phase lead is of a small value and the viscous resistance of the joint is of a large value.

27. The legged mobile robot according to claim 22 wherein, in each stage of the turning movement, said means for controlling the actuator characteristics sets the characteristics of the actuators for driving the respective joints, for which emphasis is placed on the mechanical passiveness or fast response characteristics, to second actuator characteristics in which the low range gain is of a small value, the quantity of the phase lead is of a large value and the viscous resistance of the joint is of a small value.

28. The legged mobile robot according to claim 22 wherein, in each stage in

which the link state defined by the floor touch site of the robot body and the floor surface in the course of the turning movement is switched between the open link state and the closed link state, said means for controlling the actuator characteristics switches the characteristics of the actuators for driving the respective joints between the first actuator characteristics and the second actuator characteristics.